– Solutions –

Honors Physics Midterm Practice Questions

Name: _____ Date: _____

C 1. Which of the following is a fundamental unit of the SI system of units?
A) kilometer
B) joule
C) kilogram
D) gram
E) newton

Base SI Units
Mass = kg
Length = m
Time = sec

D 2. The SI unit for mass is
A) μg
B) mg
C) g
D) kg
E) lb

E 3. The measurement 5.130×10^{-4} has 4 significant figures.
A) two
B) three
C) one
D) seven
E) four

Review all rules Sig. Figs.

A 4. The measurement 23.0040 has 6 significant figures.
A) six
B) three
C) five
D) four
E) two

D 5. A particle moves from $x_1 = 30$ cm to $x_2 = -40$ cm. The displacement of this particle is
A) 30 cm
B) 40 cm
C) 70 cm
D) –70 cm
E) – 40 cm

$\Delta x = x_f - x_i$

$= -40 - (30) = -70$ cm

The particle started at +30 cm and went backwards 70 cm to position −4 cm

D

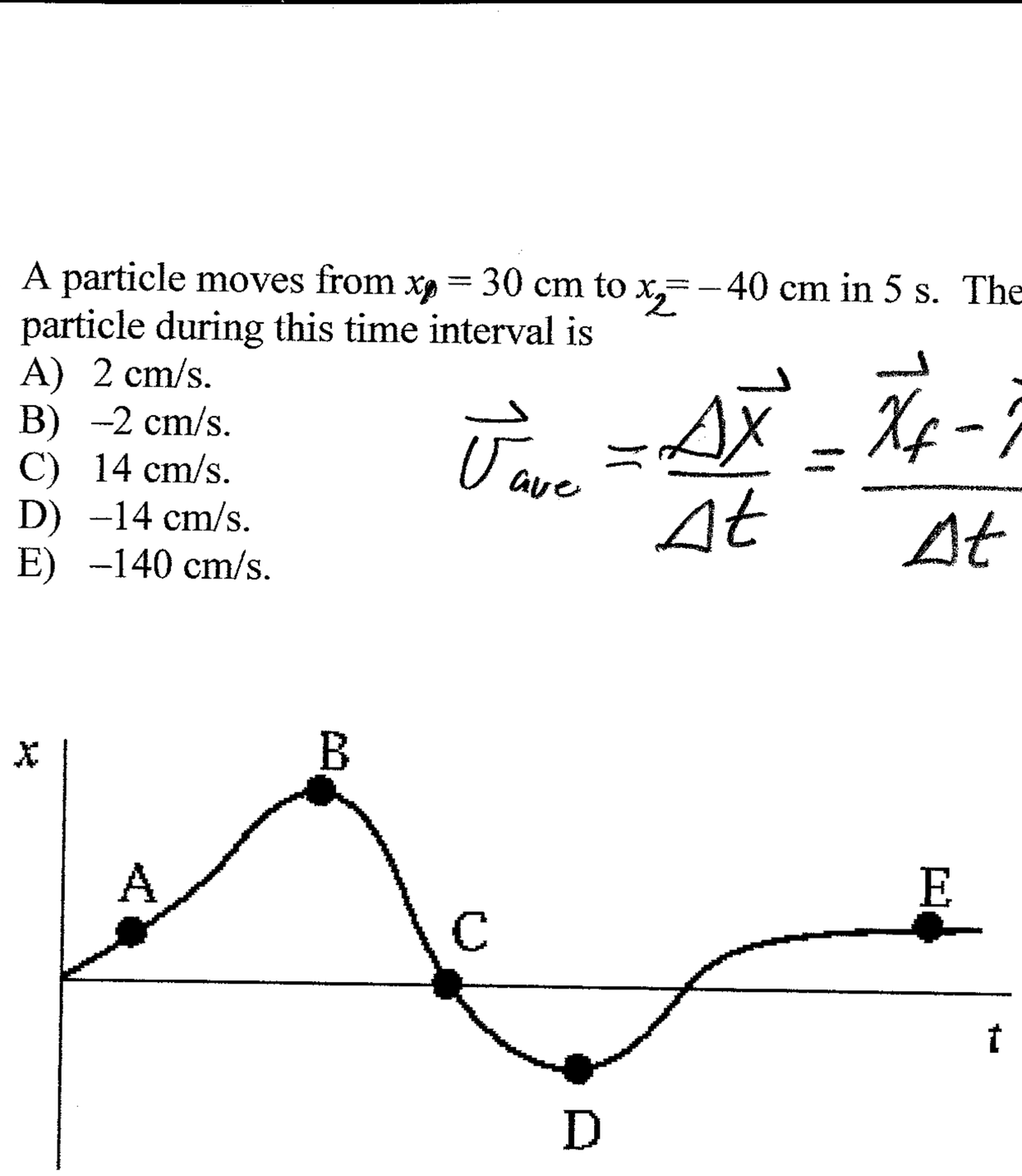
6. A particle moves from $x_1 = 30$ cm to $x_2 = -40$ cm in 5 s. The average velocity of the particle during this time interval is
   A) 2 cm/s.
   B) –2 cm/s.
   C) 14 cm/s.
   D) –14 cm/s.
   E) –140 cm/s.

$$\vec{v}_{ave} = \frac{\Delta \vec{x}}{\Delta t} = \frac{\vec{x}_f - \vec{x}_i}{\Delta t} = \frac{(-40 - 30)\,cm}{5\,s}$$

$$= \frac{-70\,cm}{5\,s} = \boxed{-14\ \frac{cm}{s}}$$

B

7.



An object, located at the origin when $t = 0$, moves along the x axis as shown in the diagram. At which point is the object farthest from its starting point?
A) A
B) B
C) C
D) D
E) E

x vs t

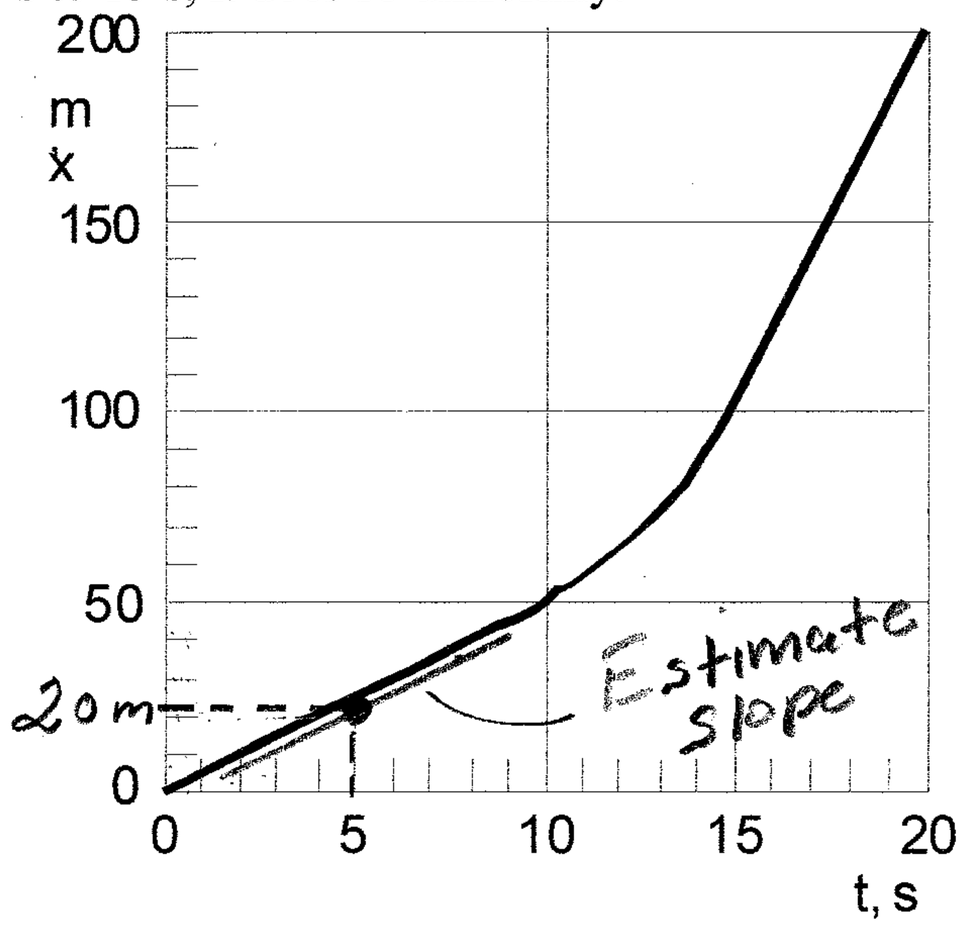
is

Position vs Time

Just read graph

Use the following to answer question 8:

The distance traveled by a car in the x-direction is shown. When the car changes speed for t = 10 s to 15 s, it does so uniformly.



$v = \frac{\Delta x}{\Delta t} = \frac{\text{rise}}{\text{run}} = \text{slope}$

$v_{\text{instantaneous}}$ = slope of Tangent

= Have to estimate in this case

$= \frac{20\,m - 0\,m}{5\,s - 0\,s} = \boxed{4\ m/s}$

A 8. The speed of the car at 5 s is about
A) 5 m/s
B) 7.5 m/s
C) 10 m/s
D) 12.5 m/s
E) 15 m/s

D 9. A particle that is moving along a straight line decelerates uniformly from 40 cm/s to 20 cm/s in 5.0 s and then has a constant acceleration of 20 cm/s^2 during the next 4.0 s. The average speed over the whole time interval is
A) 57 cm/s
B) 140 cm/s
C) 86 cm/s
D) 43 cm/s
E) 97 cm/s

4 sec at 20 cm/s2

d_1 40 cm/s, 5 sec → 20 cm/s; d_2 →

$v_f = v_i + at$

$20 = 40 + a_1(5)$

$a_1 = -4\ cm/s^2$

$\text{Speed} = \frac{d}{t} = \frac{d_1 + d_2}{t} = \frac{390\ cm}{9\ s} = 43.3$

C 10. For uniformly accelerated motion, which of the following quantities must be zero?
A) the initial velocity
B) the initial displacement
C) the rate of change of the acceleration
D) the rate of change of the velocity
E) the rate of change of the displacement

If a = constant
a not changing

$d_1 = x_i^{\,?0} + v_i t + \frac{1}{2} a t^2$

$= 40(5) + \frac{1}{2}(-4)(5)^2$

$d_1 = 200 - 50 = 150\ cm$

$d_2 = x_i^{\,?0} + v_i t + \frac{1}{2} a t^2$

$= 20(4) + \frac{1}{2}(20)(4)^2$

$d_2 = 80 + 160 = 240\ cm$

A

$v_i = 0$

11. A Triumph sports car starts at rest and accelerates uniformly to a speed of 27.0 m/s in 11.8 s. Calculate the distance the car travels during this time interval.

A) 160 m
B) 320 m
C) 1.90 km
D) 640 m
E) 350 m

$v_f = v_i + at$

$27 = 0 + a(11.8)$

$a = +2.3\ m/s^2$

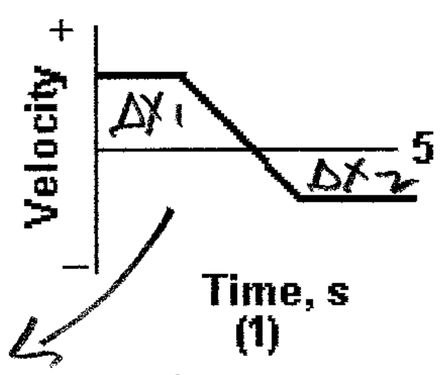
$x_f = x_i + v_i t + \frac{1}{2}at^2$

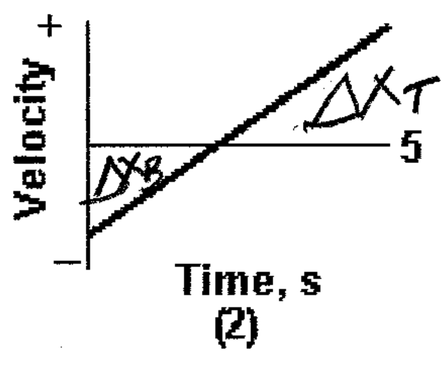
$= 0 + 0 + \frac{1}{2}(2.3)(11.8)^2$

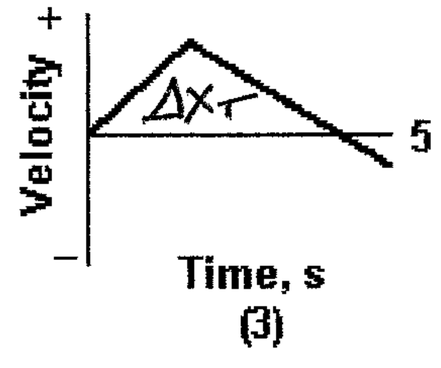
$= 160.1\ m$

E

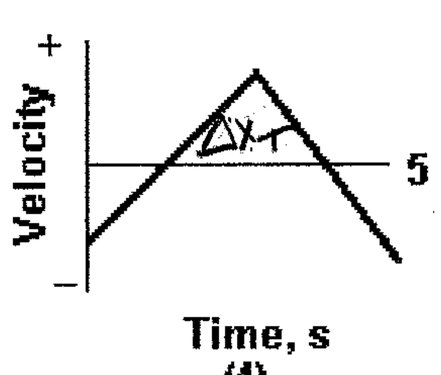
12.

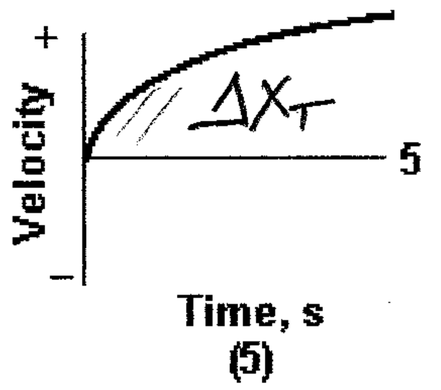






$\Delta X = \Delta X_T - \Delta X_B$





$v = \frac{\Delta x}{\Delta t}$

$\Delta x = v\,\Delta t$

$= (Height)(Base)$

on a v vs t graph

In which graph is the particle the farthest from the origin at $t = 5$ s?

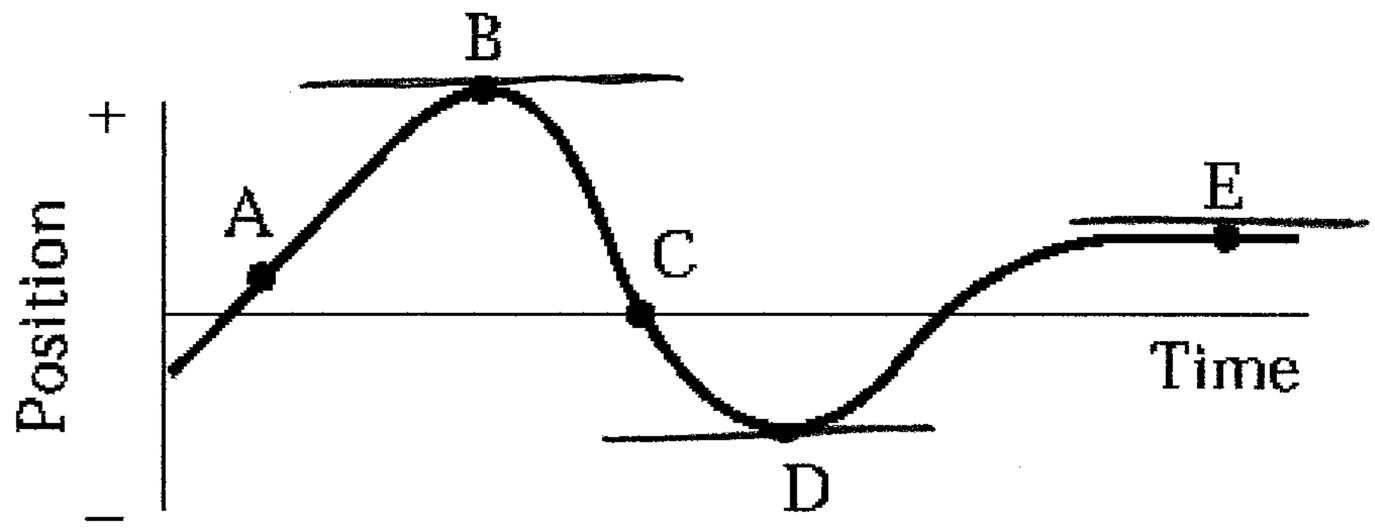
A) 1
B) 2
C) 3
D) 4
E) 5

ΔX_{Top} in graph 5 is clearly larger than any net $\Delta X_{Top} - \Delta X_{Bottom}$ from the other graphs

B 13.

$v = \frac{\Delta x}{\Delta t} = \frac{rise}{run} = slope$

= slope of Tangent for instantaneous

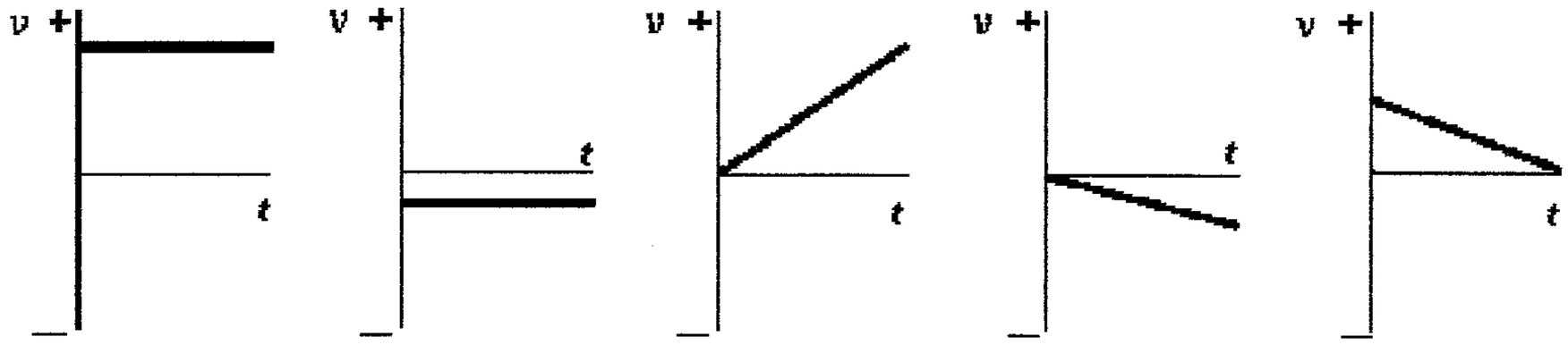


An object moves along the *x* axis as shown in the diagram. At which point or points is the object instantaneously at rest?

A) A and E
B) B, D, and E
C) C only
D) E only
E) None of these is correct.

$v = 0$ when slope $= 0$

Use the following to answer questions 14-16:



E 14. Which graph of *v* versus *t* best describes the motion of a particle with positive velocity and negative acceleration?

A) 1
B) 2
C) 3
D) 4
E) 5

velocity values are all + but object is slowing down

$a = \frac{\Delta v}{\Delta t} = \frac{rise}{run} = slope$

and slope is − in #5

D

15. Which graph of v versus t best describes the motion of a particle with negative velocity and negative acceleration?
A) 1
B) 2
C) 3
D) 4
E) 5

$-v$ and $-a$ = Going Backward and Speeding up
1
Slope

C

16. In which graph of v versus t is the magnitude of the particle's acceleration the greatest?
A) 1
B) 2
C) 3
D) 4
E) 5

$a = \frac{\Delta v}{\Delta t}$ = Slope → + or − doesn't matter for magnitude

#3 has greatest slope

C

17. A projectile is fired vertically upward with a speed of 62 m/s. In the absence of air resistance, the maximum height the projectile attains is about
A) 25 km
B) 98 m
C) 200 m
D) 19 km
E) 3 m

$v_f^2 = v_i^2 + 2a\Delta y$

$0 = (62)^2 + 2(-9.8)\Delta y$

$\Delta y = \frac{3844\ m^2/s^2}{19.6\ m/s^2} = 196\ m$

B

18. An object is at $x = -3$ m and has a velocity of 4 m/s. It is observed to be slowing down. Its acceleration is
A) positive.
B) negative.
C) zero.
D) negative until the object stops and then positive.
E) impossible to determine based on the information provided.

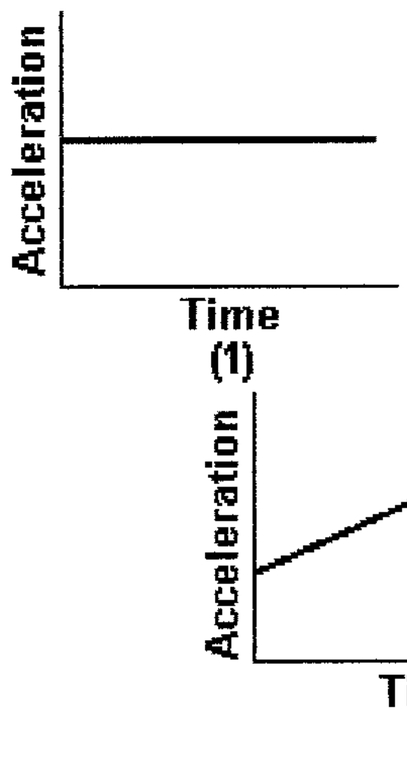
Particle is at position $x = -3$ but velocity is $+4$ m/s. Slowing down means accel. must be against velocity
∴ accel = −

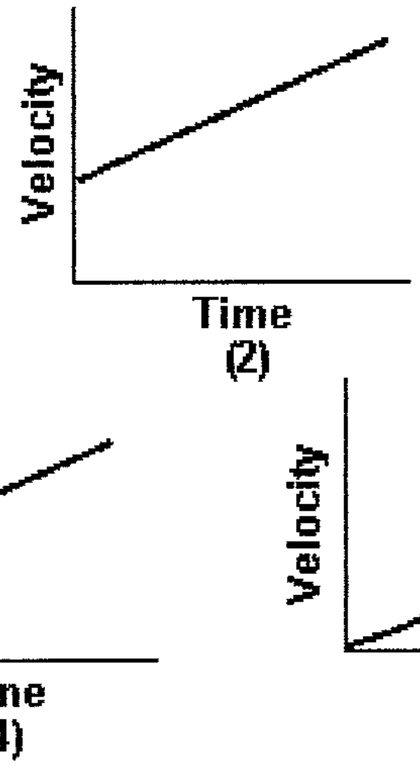
C

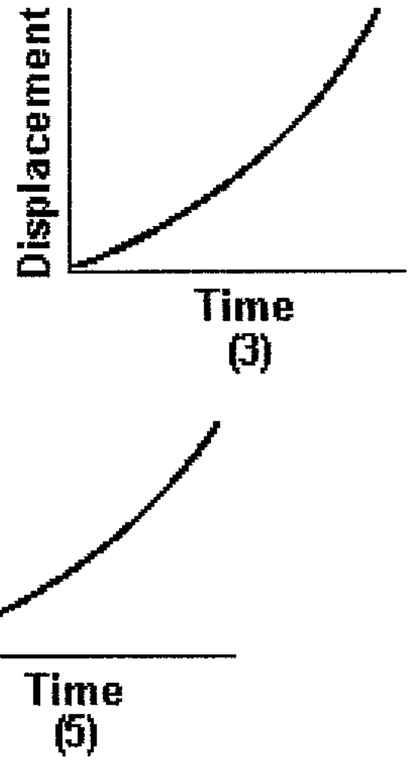
19. An object falling near the surface of Earth has a constant acceleration of 9.8 m/s^2. This means that the
A) object falls 9.8 m during the first second of its motion.
B) object falls 9.8 m during each second of its motion.
C) speed of the object increases by 9.8 m/s during each second of its motion.
D) acceleration of the object increases by 9.8 m/s^2 during each second of its motion.
E) force of gravity on the object must be 9.8 SI units.

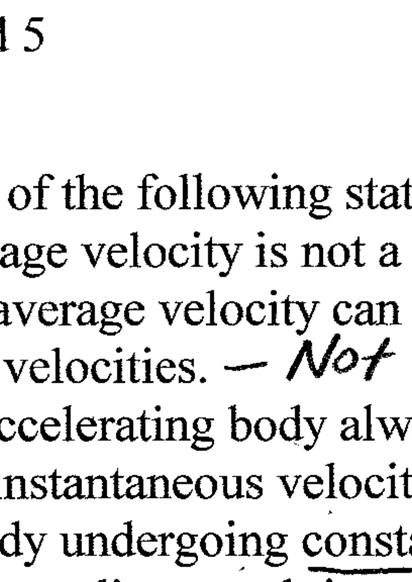
$9.8\ \frac{m}{s^2} = 9.8\ \frac{m/s}{s}$

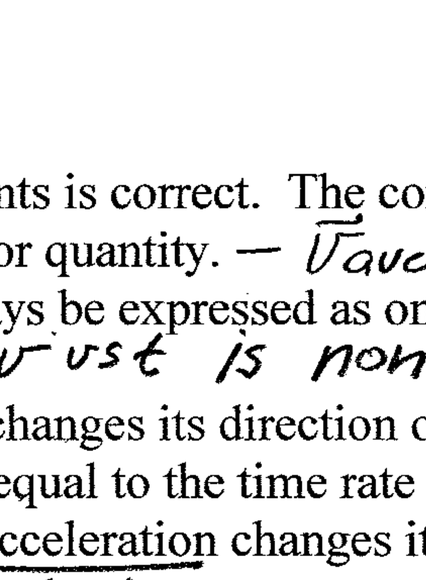
D 20.







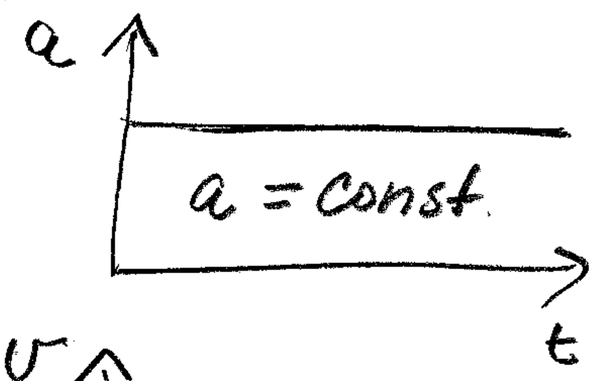


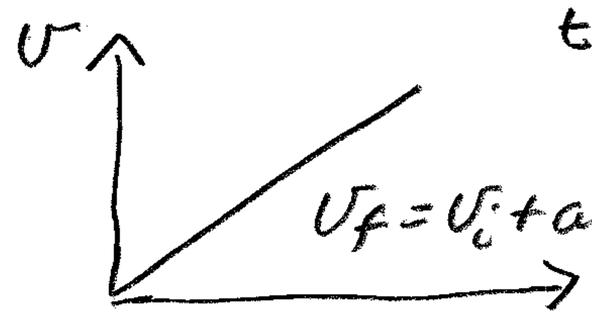


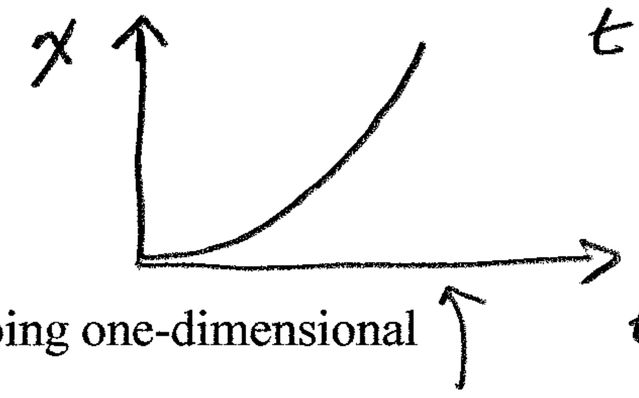
Two of the graphs shown are INCORRECT for a particle undergoing one-dimensional motion with constant acceleration. They are

A) 1 and 2
B) 2 and 3
C) 3 and 4
D) 4 and 5
E) 1 and 5

Const Accel Graphs







$x_f = x_i + v_i t + \frac{1}{2}at^2$

D 21. Only one of the following statements is correct. The correct statement is:

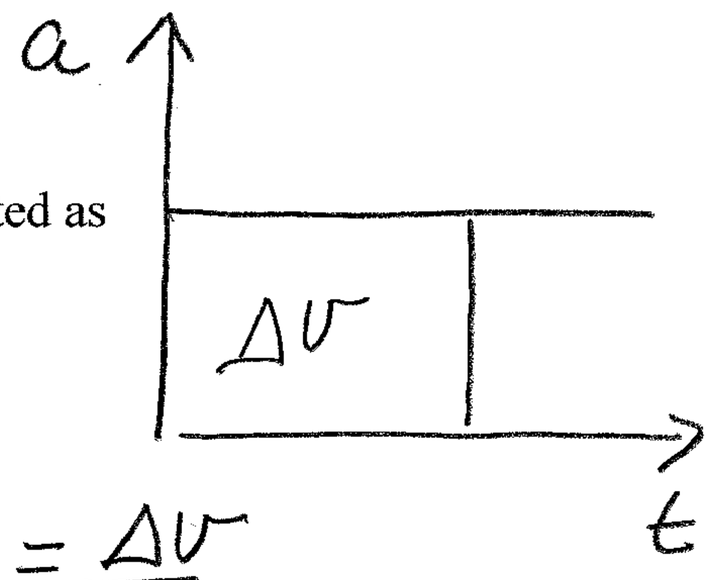
A) Average velocity is not a vector quantity. — $\vec{v}_{ave}$ is vector
B) The average velocity can always be expressed as one-half the sum of the initial and final velocities. — Not if v vs t is non-linear
C) An accelerating body always changes its direction of motion. — slowing down but not changing dir
D) The instantaneous velocity is equal to the time rate of change of the displacement. — yes $v = \frac{\Delta x}{\Delta t}$
E) A body undergoing constant acceleration changes its velocity by larger increments in succeeding equal time intervals. ↓ Same increments

D 22. A hammer and feather are dropped from the same height above the lunar surface. Which object hits the ground first?

A) the hammer
B) neither because they both float in space
C) the feather
D) both at the same time — Accel. is independent of mass
E) none of the above

C

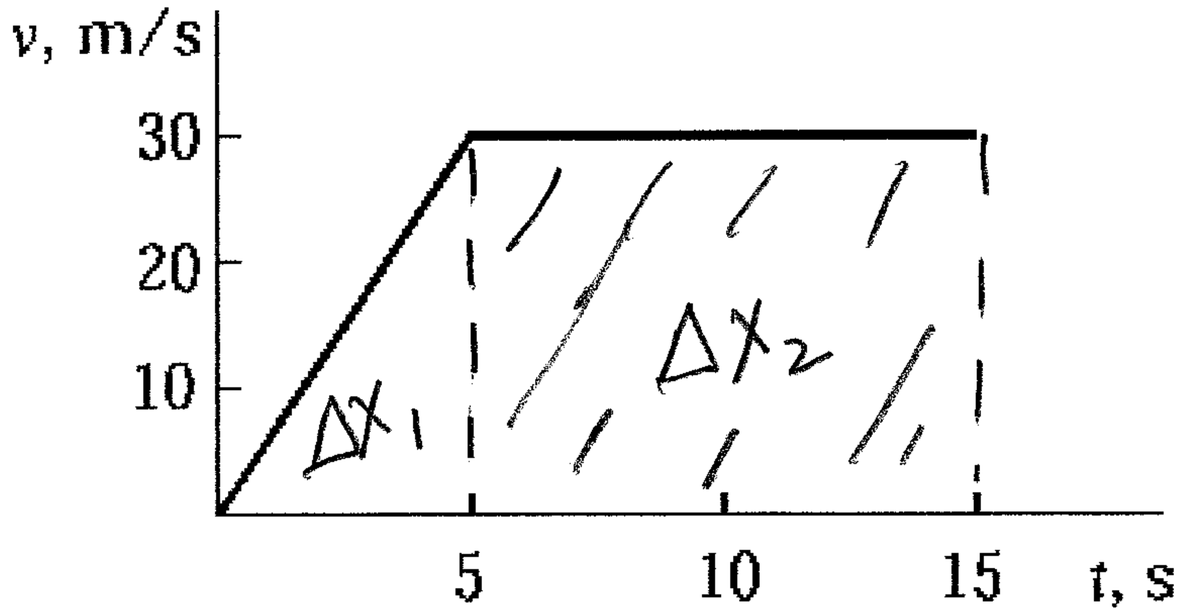
23. The change in velocity for a given time interval can be interpreted as
A) the area under the *v*-versus-*t* curve for that interval.
B) the area under the *x*-versus-*t* curve for that interval.
C) the area under the *a*-versus-*t* curve for that interval.
D) the slope of the *a*-versus-*t* curve.
E) None of these is correct.



$a = \frac{\Delta v}{\Delta t}$

E

24.



$\Delta v = a(\Delta t)$
= height (Base)

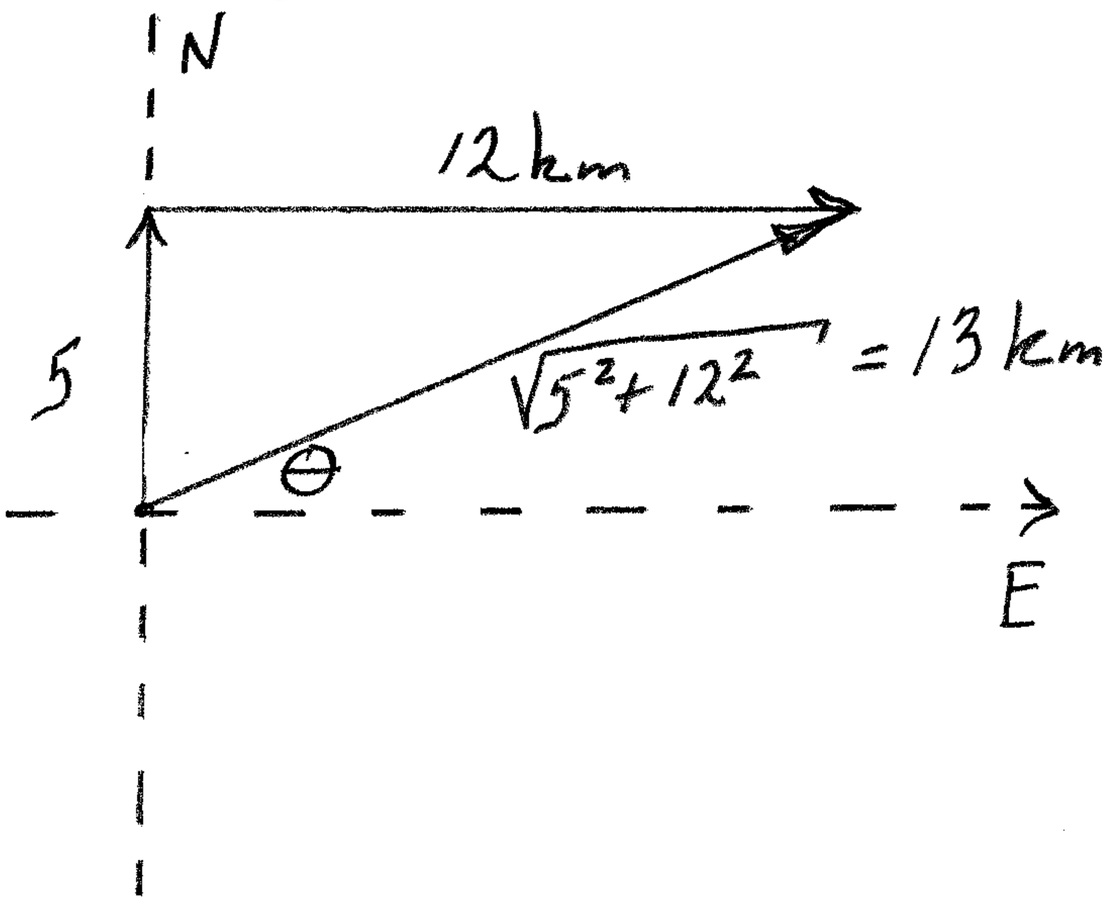
The graph shows the instantaneous velocity of a car during 15 s of its motion. The distance traveled by this car during this 15-s interval is
A) 30 m
B) 450 m
C) 300 m
D) 75 m
E) 375 m

$v = \frac{\Delta x}{\Delta t}$ $\Delta x = v(\Delta t)$ = Area

$\Delta x = \frac{1}{2}(5)(30) + (10)(30) = 375\ m$

A

25. You walk 5 km north and then 12 km east. Your resultant displacement is
A) 13 km at an angle of 22.6° north of east.
B) 13 km at an angle of 67.4° north of east.
C) 17 km at an angle of 22.6° north of east.
D) 17 km at an angle of 67.4° north of east.
E) None of these is correct.



$\theta = \tan^{-1}\left(\frac{5}{12}\right)$

$= 22.6°$

$\hat{\imath} = \hat{x} \quad \hat{\jmath} = \hat{y}$

D 26. The position vector of an object is given by $\vec{r}_1 = 2\hat{i} + 3\hat{j}$ and 4 s later, its position vector is $\vec{r}_2 = -2\hat{i} + 7\hat{j}$. The units are in m. The change in the position vector $\Delta\vec{r}$, in m, is

$\Delta\vec{r} = \vec{r}_f - \vec{r}_i$

A) $4\hat{i} - 4\hat{j}$
B) $-10\hat{j}$
C) $-4\hat{i} - 4\hat{j}$
D) $-4\hat{i} + 4\hat{j}$
E) None of the above

$\vec{r}_2 = -2\hat{x} + 7\hat{y}$

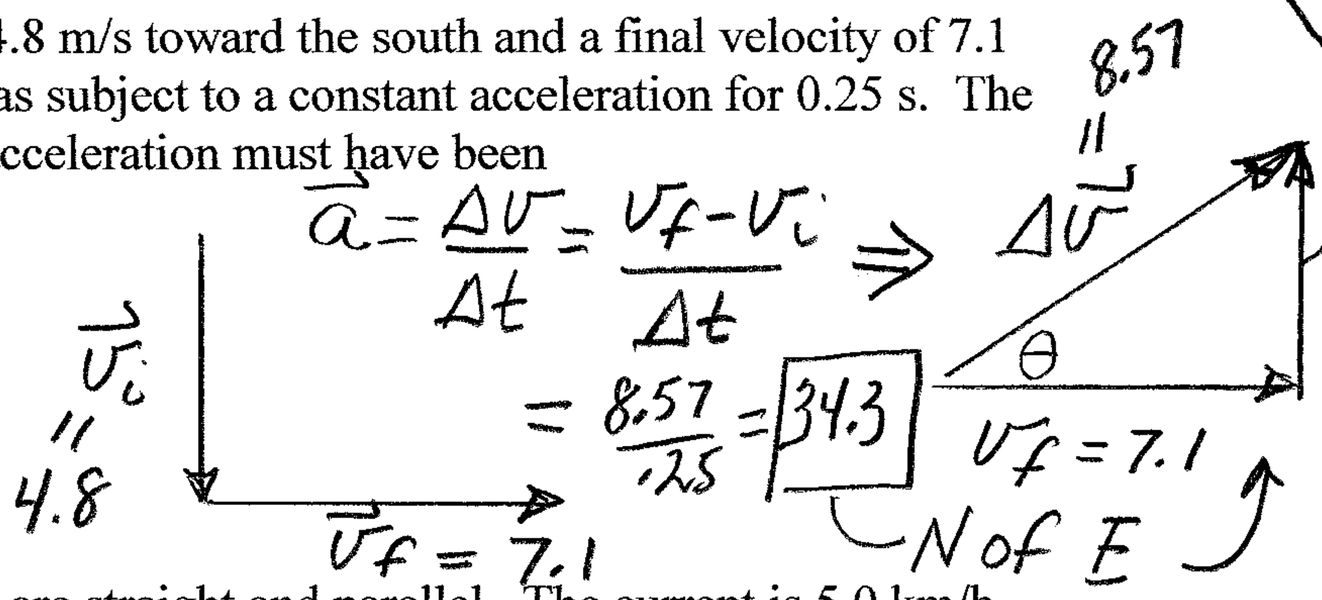
$-\vec{r}_1 = -2\hat{x} - 3\hat{y}$

$\Delta\vec{r} = -4\hat{x} + 4\hat{y}$

$|\Delta\vec{v}| = 4.8$

C 27. A particle has an initial velocity of 4.8 m/s toward the south and a final velocity of 7.1 m/s toward the east. The particle was subject to a constant acceleration for 0.25 s. The magnitude and the direction of the acceleration must have been

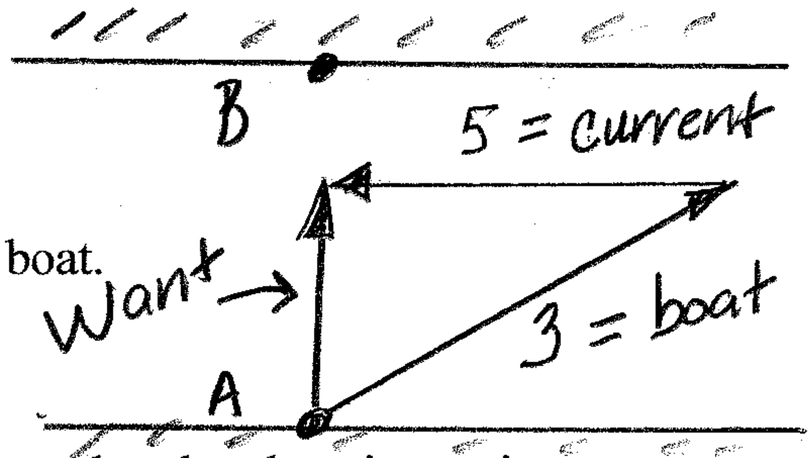
A) 8.6 m/s² at 34.1° north of east
B) 260 m/s² at 34.1° south of east
C) 34 m/s² at 34.1° north of east
D) 34 m/s² at 34.1° south of east
E) 8.6 m/s² at 34.1° south of east



D 28. A river is 0.76 km wide. The banks are straight and parallel. The current is 5.0 km/h and is parallel to the banks. A boat has a maximum speed of 3 km/h in still water. The pilot of the boat wishes to travel on a straight line from A to B, where AB is perpendicular to the banks. The pilot should

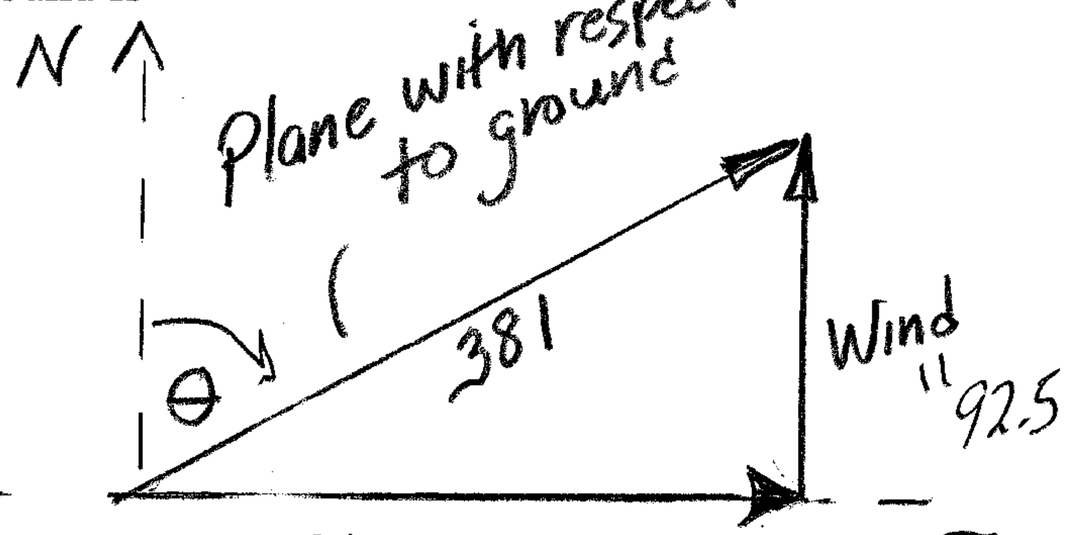
A) head directly across the river.
B) head 68° upstream from the line AB.
C) head 22° upstream from the line AB.
D) give up. The trip from A to B is not possible with this boat.
E) do none of these.

Boat must have speed greater than 5



C 29. An airplane is heading due east. The airspeed indicator shows that the plane is moving at a speed of 370 km/h relative to the air. If the wind is blowing from the south at 92.5 km/h, the velocity of the airplane relative to the ground is

A) 357 km/h at 14° east of north.
B) 381 km/h at 104° east of north.
C) 381 km/h at 76° east of north.
D) 357 km/h at 76° east of north.
E) 381 km/h at 14° east of north.



$\theta = \tan^{-1}\left(\frac{370}{92.5}\right) = 76°\ E\ of\ N$

B 30. If you ignore air resistance in projectile motion, the _____ of the projectile remains constant.

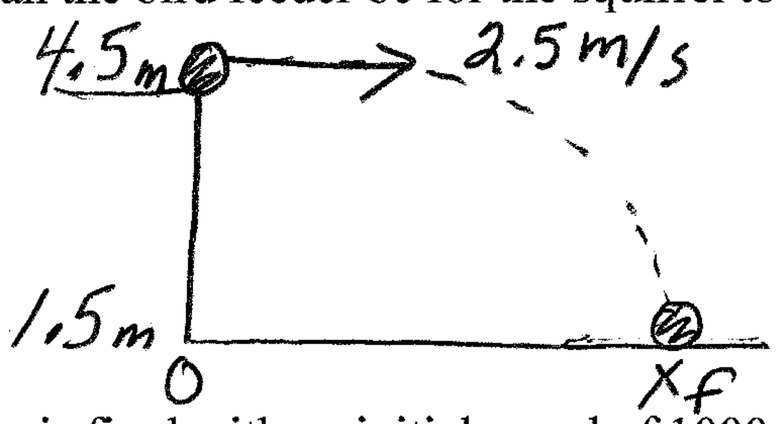
A) velocity vector
B) horizontal component of the velocity vector
C) vertical component of the velocity vector
D) speed
E) range

$a_x = 0 \qquad a_y = -9.8 \frac{m}{s^2}$

$v_x = const$

B 31. A naughty squirrel jumps from a tree limb onto a birdfeeder. The tree limb is 4.5 m above the ground and the top of the birdfeeder is 1.5 m above the ground. If the squirrel jumps horizontally with a velocity of 2.5 m/s then how far away in the horizontal direction can the bird feeder be for the squirrel to just make it onto the top of the feeder.

A) 3.6 m
B) 2.0 m
C) 2.4 m
D) 1.5 m
E) 1.4 m



y-dir

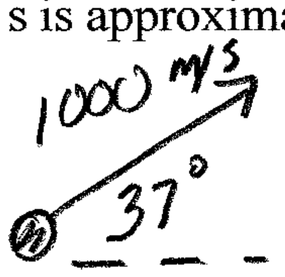
$y_f = y_i + v_{iy}^{\nearrow 0} t + \frac{1}{2}(-9.8)t^2$

$1.5 = 4.5 - 4.9t^2$

$t = .78$ sec

B 32. A projectile is fired with an initial speed of 1000 m/s at an angle of 37° above the horizontal. If air resistance is neglected, the horizontal component of the projectile's velocity after 20 s is approximately

A) 600 m/s
B) 800 m/s
C) 640 m/s
D) 40 m/s
E) 160 m/s



$v_x = 1000 \cos 37° = 799$ m/s

x-dir

$x_f = x_i^{\nearrow 0} + v_{ix}t + \frac{1}{2}a_x^{\nearrow 0}t^2$

$= 2.5(.78)$

$= \boxed{1.95 m}$

D 33. A body moves with constant speed in a straight line. Which of the following statements must be true?

A) No force acts on the body.
B) A single constant force acts on the body in the direction of motion.
C) A single constant force acts on the body in the direction opposite to the motion.
D) A net force of zero acts on the body.
E) A constant net force acts on the body in the direction of motion.

$F_{net} = ma$

E 34. A net force of 64 N acts on a mass of 16 kg. The resulting acceleration is

A) 16 m/s²
B) 0.51 m/s²
C) 64 m/s²
D) 9.0 m/s²
E) 4.0 m/s²

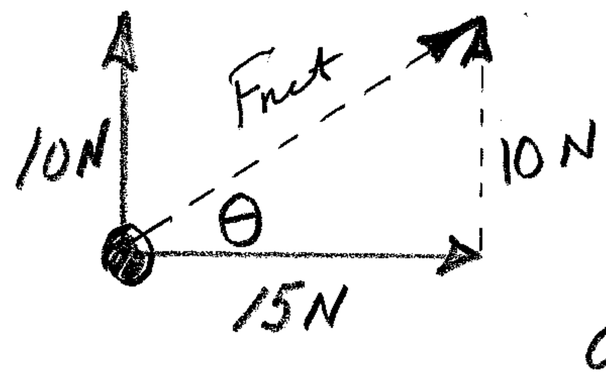
$F_{net} = ma$

$64 N = 16 kg\ (a)$

$a = 4 m/s^2$

C

35. A mass of 25 kg is acted on by two forces: $\vec{F}_1$ is 15 N due east, and $\vec{F}_2$ is 10 N due north. The acceleration of the mass is
A) 0.72 m/s², 56.3° north of east.
B) 0.20 m/s², due east.
C) 0.72 m/s², 33.7° north of east.
D) 1.0 m/s², 33.7° north of east.
E) 0.20 m/s², 56.3° north of east.



$F_{net} = 15N\hat{x} + 10N\hat{y}$

$= \sqrt{15^2 + 10^2}$

$= \sqrt{325} = 18\,N$

$a = F_{net}/m = \frac{18}{25} = .72$

$\theta = \tan^{-1}\left(\frac{10}{15}\right)$

$= 33.7°$

D

36. An object is moving to the right at a constant speed. Which one of the following statements must be correct?
A) No forces are acting on the object.
B) A larger number of forces are acting on the object to the right than to the left.
C) The net force acting on the object is to the right.
D) No net force is acting on the object.
E) Just one force is acting on the object, and it is acting downward.

A

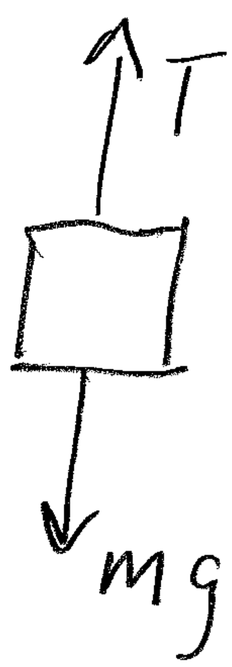
37. The SI unit of force is the
A) newton
B) gram
C) pound
D) kilogram
E) None of these is correct.

D

38. The word "normal," as it applies to forces, means
A) usual.
B) mean.
C) average.
D) perpendicular.
E) straight up, in the direction opposite to the force of gravity.

A

39. A vertical rope is attached to an object that has a mass of 40.0 kg and is at rest. The tension in the rope needed to give the object an upward speed of 3.50 m/s in 0.700 s is
A) 592 N
B) 390 N
C) 200 N
D) 980 N
E) 720 N



$T - mg = ma$

$T - 40(9.8) = 40(5)$

$\boxed{T = 592\,N}$

$v_f = v_i + at$

$3.5 = a(.7)$

$a = 5$

D

40. A ball of mass 2.0 kg is acted on by two forces, $\vec{F}_1 = 3.0N\,\hat{i} + 4.0N\,\hat{j}$ and $\vec{F}_2 = -5.0N\,\hat{i} + 6.0N\,\hat{j}$. The magnitude of the acceleration is

A) 2.5 m/s²
B) 3.9 m/s²
C) 4.6 m/s²
D) 5.1 m/s²
E) 5.8 m/s²

$F_1 = 3\hat{x} + 4\hat{y}$

$+ F_2 = -5\hat{x} + 6\hat{y}$

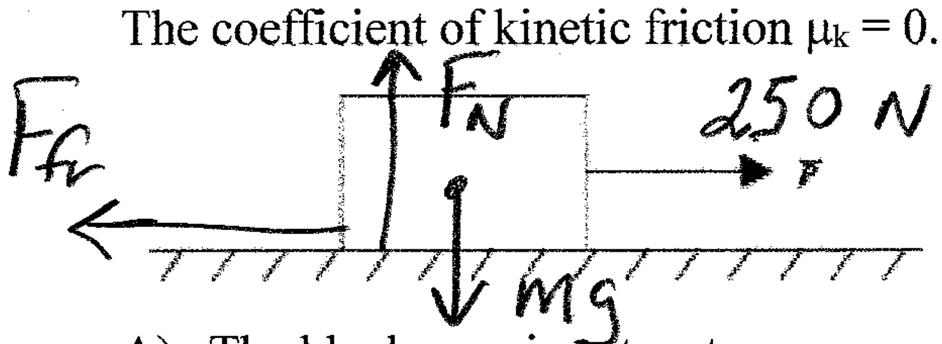
$F_{net} = -2\hat{x} + 10\hat{y}$

$F_{net} = \sqrt{2^2 + 10^2} = 10.2\ N$

$a = \frac{F_{net}}{m} = \frac{10.2\ N}{2\ kg} = 5.1\ m/s^2$

C

41. A 50-kg block rests on a horizontal surface. The coefficient of static friction $\mu_a = 0.50$. The coefficient of kinetic friction $\mu_k = 0.35$. A force $\vec{P}$ of 250 N is applied as shown.



$F_N = mg = 50(9.8) = 490\ N$

$F_{fr\,static} = \mu F_N = .5(490) = 245\ N$

$F_{fr\,kinetic} < 245\ N$

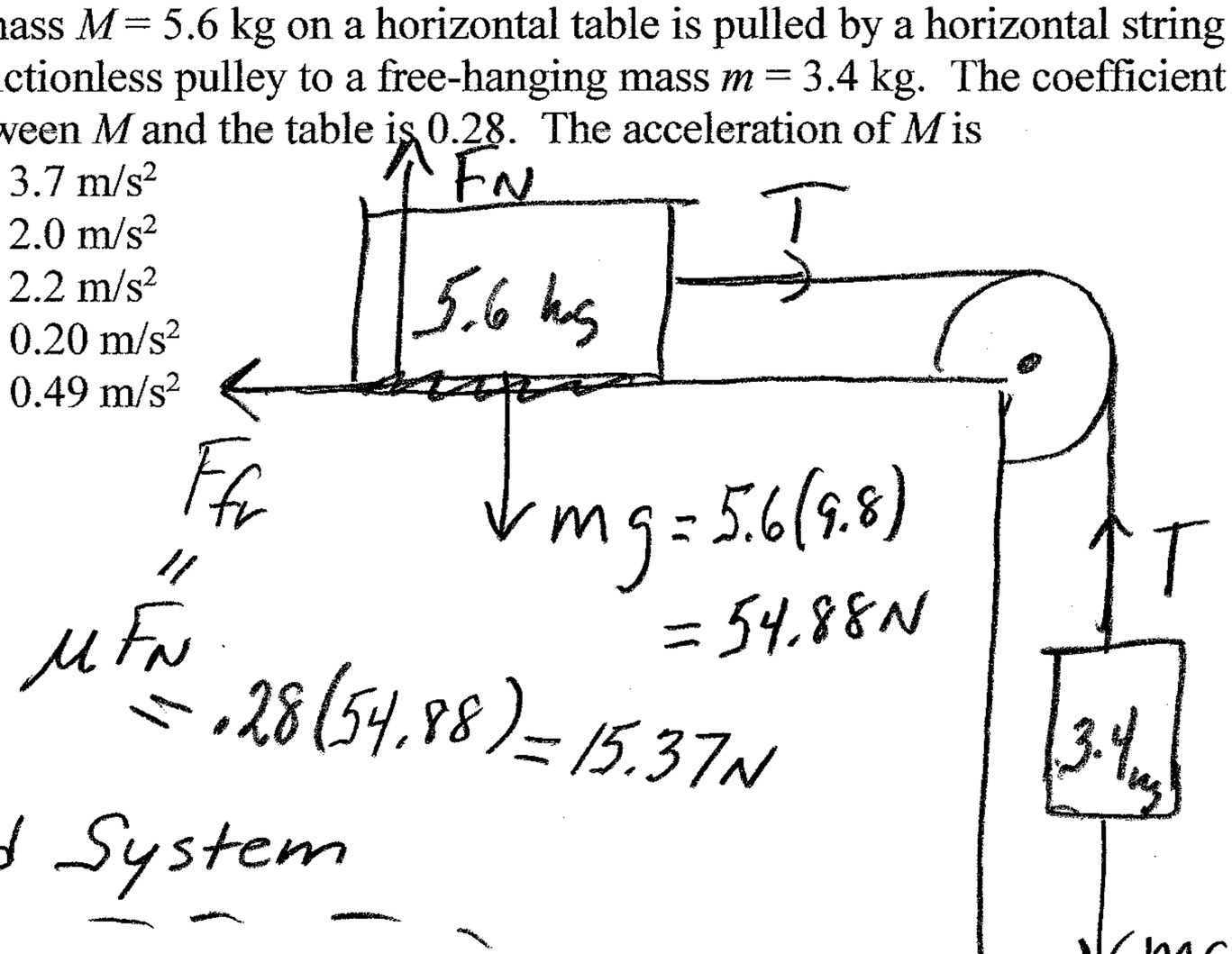
$\therefore$ 250 N wins

A) The block remains at rest.
B) The block moves and continues to move at constant velocity.
C) The block accelerates to the right.
D) The block does not move until $\vec{P}$ is increased to greater than 490 N.
E) No conclusions can be drawn concerning the movement of the block from the information given.

B

42. A mass $M = 5.6$ kg on a horizontal table is pulled by a horizontal string that passes over a frictionless pulley to a free-hanging mass $m = 3.4$ kg. The coefficient of friction between M and the table is 0.28. The acceleration of M is

A) 3.7 m/s²
B) 2.0 m/s²
C) 2.2 m/s²
D) 0.20 m/s²
E) 0.49 m/s²

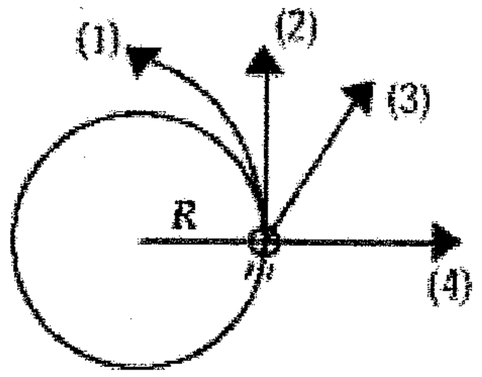


$F_{net} = ma \rightarrow 33.3 - 15.37 = (5.6 + 3.4)a$

$a = \frac{17.93}{9} = \boxed{1.99\ m/s^2}$

B

43. The figure shows a *top view* of a ball on the end of a string traveling counterclockwise in a circular path. The speed of the ball is constant. If the string should break at the instant shown, the path that the ball would follow is



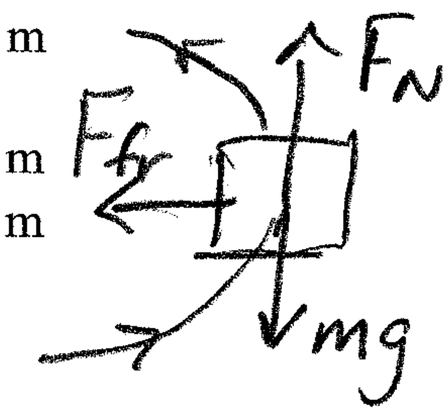
$\vec{v}$ = tangent always

A) 1
B) 2
C) 3
D) 4
E) impossible to tell from the given information.

E

44. A proud new Jaguar owner drives her car at a speed of 25 m/s into a corner. The coefficients of friction between the road and the tires are 0.70 (static) and 0.40 (kinetic). What is the minimum radius of curvature for the corner in order for the car not to skid?

A) 3.5×10^2 m
B) 64 m
C) 2.1×10^2 m
D) 1.6×10^2 m
E) 91 m



$F_{rad} = m\frac{v^2}{r}$

$\mu F_N = m\frac{v^2}{r}$

$\mu mg = m\frac{v^2}{r}$

$r = \frac{v^2}{\mu g}$

$r = (25)^2/(.7)(9.8)$

$= 91.1\text{m}$

D

45. A particle is moving uniformly in a circle with radius 50 cm. The linear speed of the particle is 60 cm/s. The acceleration of the particle has a magnitude of

A) zero
B) 36 m/s^2
C) 1.8×10^5 cm/s^2
D) 72 cm/s^2
E) 3.6 m/s^2

$$a = \frac{v^2}{r} = \frac{(60\ \text{cm/s})^2}{(50\ \text{cm})}$$

$$= 72\ \frac{\text{cm}}{\text{s}^2}$$

Answer Key

1. C
2. D
3. E
4. A
5. D
6. D
7. B
8. A
9. D
10. C
11. A
12. E
13. B
14. E
15. D
16. C
17. C
18. B
19. C
20. D
21. D
22. D
23. C
24. E
25. A
26. D
27. C
28. D
29. C
30. B
31. B
32. B
33. D
34. E
35. C
36. D
37. A
38. D
39. A
40. D
41. C
42. B
43. B
44. E
45. D